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(71) Applicant *(for all designated States except US)*: MICROPULSE, INC. [US/US]; 4510 Commercial Avenue, Portage, MI 49002 (US).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: TAPPEL, James, G. [US/US]; 7550 Benders Road, Hickory Corners, MI 49060 (US).

(74) Agent: DAVIS, Mark, A.; Rader, Fishman, Grauer McGarry, Suite 600, 171 Monroe Avenue, N.W., Grand Rapids, MI 49503 (US).

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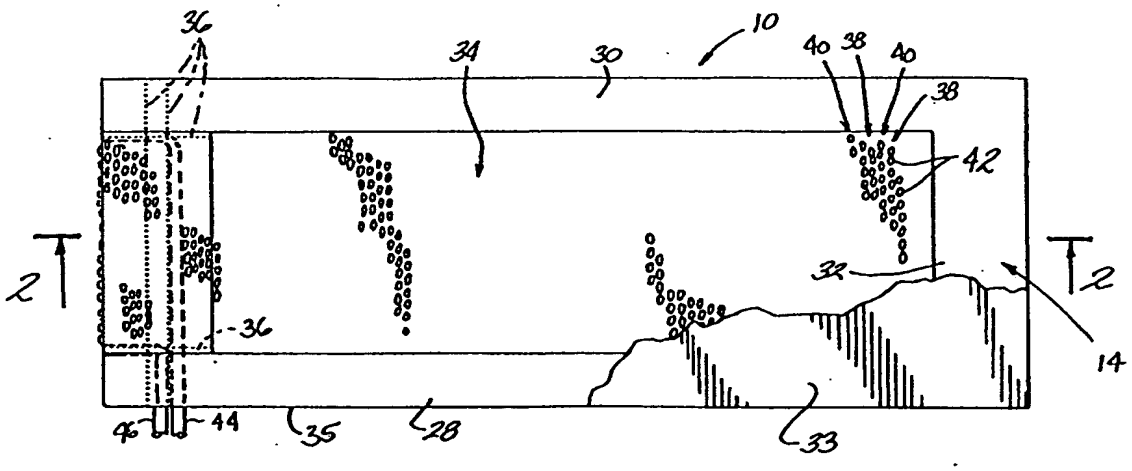

(57) Abstract

A mattress support system for a mattress designed to reduce the occurence of the decubitus ulcers. The mattress support system comprises a base (12) surrounded by a peripheral frame (14). An air mattress (34) is provided on the base (12) between the peripheral frame (14). The peripheral frame (14) helps maintain the air mattress in a laterally stable position. Additionally, the base and the frame are tapered at a lower end (26) to provide better support for the calcanel tendon to reduce the pressure on the user's heel. The mattress support system can include a cover (142) that receives the mattress within an enclosed chamber and a second open–ended chamber adapted to envelop an existing mattress to mount the air mattress on top of an existing mattress.

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MATTRESS SUPPORT SYSTEM

Related Cases:

This application claims priority from U.S. Provisional Patent Application Serial No. 60/038477, filed February 24, 1997.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to a mattress support system, and, more specifically, to a mattress support system for reducing decubitus ulcers in non-ambulatory or partially immobile persons.

Description of the Related Art

It is widely known that non-ambulatory or partially immobile persons who are confined to a bed for extended periods of time are at an increased risk for developing decubitus ulcers. Decibitus ulcers (pressure ulcers, pressure sores, or bedsores) are mainly caused by reduced capillary blood flow at localized portions of the person's skin. The reduction in capillary blood flow is generally caused by a bony prominence in the person's skeletal structure compressing the person's skin against the bed or other support.

It is known that reducing or elevating the pressure on the skin between the person's bony protrusion and the mattress will reduce or retard the of decubitus ulcers. A standard hospital remedy is to move non-ambulatory or partially immobilized persons into different positions at least every two hours. Several types of mattresses have been developed to decrease the likelihood of developing decubitus ulcers by redistributing the person's weight away from the bony protrusions or alternating the areas of the person's body bearing its weight.

A typical mattress includes a plurality of inflatable cells that are generally arranged in two series. The series of cells are typically arranged in an adjacent pattern and are alternatively inflated and deflated so that the person's body

weight is carried between the alternately inflated cells. In essence, the person's weight is transferred from the area of the person's body corresponding to the inflated cells. Examples of these types of mattresses are shown in U.S. Patents 5,010,608, issued April 30, 1991; 4,225,989, issued October 7, 1980; 4,193,149, issued March 18, 1980; and 4,391,009, issued July 5, 1983.

Although many of these mattresses perform satisfactorily in reducing the occurrences of decubitus ulcers, they are often inconvenient to use. For example, the air mattresses are generally unsupported along their boundaries and tend to shift and move over time. Furthermore, the air mattresses lack in ease of mobility.

SUMMARY OF THE INVENTION

The invention overcomes the deficiencies of previous air mattresses by providing a well supported air mattress that is convenient to use and easily mobile.

In one aspect, the invention is a mattress support system comprising an inflatable support having at least two series of inflatable cells and a base support having an upper surface for supporting the inflatable support. The base support comprises a main portion and a tapered heel portion.

In another aspect, the invention is a mattress support comprising a base support and an inflatable support. The base support has an upper surface and an opposite lower surface. The inflatable support has multiple cells disposed on at least a portion of the upper and lower surfaces of the base support.

In yet another aspect, the invention is a method of operating a mattress support system having at least two series of inflatable cells. The series of inflatable cells are sequentially inflated and deflated by delaying the deflation of one of the series of cells until after the other of the series of cells are completely inflated to thereby ensure an overlap in the inflated state of at least two series of the series of cells for adequate support of a person lying on the cells.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a mattress support system according to the invention;

FIG. 2 is a cross section of the mattress support system taken along line 2-2 of FIG. 1;

FIG. 3 is a diagrammatic illustration of a control system for operating the mattress support system according to the invention;

FIG. 4 is a diagrammatic view of a timing cycle for use with the controller system of FIG. 3;

FIG. 5 is a diagrammatic view of the cycle times for the various components of the control system of FIG. 3;

FIG. 6 is a diagrammatic view of the pressure levels in the two rows of cells during normal operation;

FIG. 7 is a perspective view of a mattress according to a second embodiment of the invention; and

FIG. 8 is a sectional view of a third embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the figures, and more particularly to FIGS. 1 and 2, one embodiment of a mattress support system 10 according to the invention includes a base layer 12, a frame layer 14, and a heel portion 16. The base layer 12 is constructed of a foam of the type having a resiliency that is sufficient to support and conform to the contours of a person placed thereon. The base layer 12 is approximately five inches thick and includes relatively planar upper and lower surfaces 15 and 24.

The heel portion 16 extends from a foot end 18 of the base layer 12. The heel portion includes an upper surface 20 and a lower surface 22 with the upper surface being slanted with respect to a lower surface. The lower surface 22 of the heel portion 16 and the lower surface 24 of the base layer 12 extend along the same plane such that the mattress 10 can be supported on a bed or other support surface. The heel portion 16 tapers from about 5" at the foot end 18 of the base layer 12 to approximately 3" at the outer end 26 of the heel portion 16.

The frame layer 14 is approximately one inch in thickness and is attached to the upper surface 15 of the base layer 12 and the upper surface 20 of the

heel portion 16. The frame layer is preferably constructed of a foam that exhibits greater resiliency than the base layer 12 and can readily accept and hold syringe needles during emergency procedures. The thickness of the frame layer 14 is approximately one inch to give an overall height of approximately six inches to the mattress 10. The frame layer 14 includes a pair of longitudinally extending legs 28, 30, connected by a bight portion 32. The legs 28 and 30 extend along the length of the base foam layer 12 and the heel portion 16 and terminate at the outer end 26 of the heel portion 16. The legs 28 and 30 are parallel to each other and perpendicular to the bight portion 32. The legs 28 and extend along opposite peripheral portions of the base layer 12 and heel portion 16.

The base foam layer 12, the frame layer 14, and the heel portion 16 are preferably constructed of an open cell anti-microbial foam and are connected together through well known adhesives or other known bonding techniques. A plastic outer covering 33 encases the foam layers 12, 14, and the foam heel portion 16 for protection against outside contaminants.

An inflatable support member 34 is positioned on the top surface 15 of the base foam layer 12 between the legs 28, 30 and extends from the bight portion 32, along the upper surface 20 of the heel portion 16 and wraps around the outer end 26 of the heel portion 16. The inflatable support member 34 is positioned loosely on the base layer upper surface 15 and the heel portion upper surface 20 and occupies substantially the entire recess defined by the legs 28, 30 and bight portion 32. The portion of the inflatable support member 34 that extends along the bottom surface 22 serves to frictionally maintain the inflatable support member in position when the mattress 10 is placed on a support service. In an alternative arrangement, the inflatable support member can terminate at the junction of the outer end 26 and bottom surface 22. The inflatable support member 34 includes a plurality of cells 42 that are positioned in laterally extending staggered rows 38 and 40. All of the rows 38 and cells 42 located therein are fluidly connected so as to produce a first matrix of interconnected cells. Likewise, all of the rows 40 and the cells 42 located therein are fluidly connected so as to produce a second matrix of interconnected cells that is

independent from the first matrix. The cells are inflatable and deflatable with the application and withdrawal of air pressure. A suitable inflatable support member 34 is disclosed in greater detail in U.S. Patent No. 5,010,608, the disclosure of which is hereby incorporated by reference.

The rows 38 of cells 42 are connected to a supply tube 44 while the rows 40 of cells 42 are connected to a supply tube 46. The supply tubes 44, 46 extend along slits 36 in the heel portion 16 and base layer 12 and exit at one side 35 of the mattress 10 for connection to an air pressure/exhaust port. The first and second matrices are alternately inflated and deflated as will be described in greater detail below. The thickness of the inflatable support member is preferably substantially equal to the thickness of the frame layer 14 to as to provide an even upper surface on the mattress 10.

The upper tapered surface 20 of the heel portion 16 receives the heels of a user when the user is laying down with his/her back facing the inflatable support member 34. In this position, the arch in the patient's calcaneal tendon is firmly supported to distribute pressure from the weight of the patient's legs and feet over the calcaneal tendon and heel to thereby reduce or eliminate heel pressure against the mattress and the occurrence of decubitus ulcers in the heel region. Instead of a linear tapered surface, the heel portion 16 may be rounded or of some other shape, so long as pressure is relieved from the patient's heels.

Referring now to FIG. 3, a control unit 50 for selectively inflating and deflating the cells in the first matrix of rows 38 and the second matrix of rows 40 includes an air pump 52 fluidly connected to a pressure sensor 54 via a first air supply line 56 and to a pair of check valves 58 and 60 via a second air supply line 62 and third air supply line 64. The check valves 58, 60 are one-way check valves that permit the passage of fluid such as air through the valves under pressure in a direction represented by arrows 66 and 68, respectively. The first check valve 66 is fluidly connected to a first solenoid valve 70 via a fourth air supply line 72. The solenoid valve 70 includes an input port 74 that receives air under pressure from the air pump 52, an output port 76 connected to a fifth air supply line 78 and an exhaust port 80.

The fifth air supply line 78 is fluidly connected to the air supply tube 44 (manifold A) for inflating and deflating the cells in the first matrix of rows 38.

The second solenoid valve 82 is fluidly connected to the second check valve 60 through a sixth air supply line 84. The second solenoid valve 82 is identical in construction to the first solenoid valve 70 and includes an input port 86 for receiving air under pressure from the air pump 52, an output port 88 fluidly connected to a seventh air supply line 90 and an exhaust port 92. The seventh air supply line 90 is fluidly connected to the second air supply tube 46 (manifold B) to inflate and deflate the cells 42 in the second matrix of rows 40.

A controller 93 is preferably in the form of a printed circuit board, is adapted to control operation of the air pump 52 and the solenoid valves 70, 82. An electrical cable 94 and plug 96 provide electrical power to the controller 92. An electrical cable 98 extends between the controller 92 and the air pump 52 so that electrical power can be selectively supplied to operate the air pump 52. Electrical cables 100 and 102 extend between the controller and the solenoid valves 70 and 82, respectively, to selectively operate the solenoid valves. The pressure sensor 54 is also connected to the controller 92 through an electrical cable 104 that transmits electrical signals representative of fluid pressure from the sensor 54 to the controller.

With reference now to FIGS. 3 - 6, operation of the mattress support system will now be described. Initially, the cells 42 of the inflatable support member 34 are deflated. When energized, the controller 92 supplies an electrical signal to the solenoid valves 70 and 82 such that fluid communication is established between the input and output ports of each solenoid valve. The air pump 52 is then actuated by the controller 92 to cause air under pressure to fill and pressurize the cells 42 of each matrix of rows 38, 40. In this manner, the cells 42 of each row 30, 40 are simultaneously inflated to a predetermined pressure over a short time period as represented by a first time interval 106. Preferably, the predetermined pressure is approximately 4 psi, as measured by the pressure sensor 54. When the pressure is equal to the predetermined pressure, the air pump is turned off and the solenoid valve 82 is actuated by the controller 92 to close fluid communication between the input

port 86 and the output port 88 and to open fluid communication between the output port 88 and the exhaust port 92 for a second time interval 108. In this manner, the air in the cells 42 of the rows 40 is vented to atmosphere to thereby deflate the cells to atmospheric pressure. Simultaneously, the pressure sensor 54 monitors the air pressure in the cells 42 of the rows 38 for the predetermined time interval 108. At the end of the time interval 108, the fluid connection between the output port 88 and the exhaust port 92 of the solenoid valve 82 is cut off and fluid communication is established between the input port 86 and the output port 88. Simultaneously, the air pump 52 is actuated by the controller 92 to inflate the cells 42 of the rows 40 to the predetermined pressure during a third time interval 110 which is substantially equal to the first time interval 106. During repressurization of the rows 40, the rows 38 are unaffected by operation of the air pump 52 since the cells 42 in the rows 38 are already pressurized to the predetermined pressure.

Once the cells 42 in the rows 40 are pressurized to the predetermined pressure, the fluid connection between the input port 74 and the output port 76 of the solenoid valve 70 is closed and the fluid connection between the output port 76 and the exhaust port 80 is opened to thereby deflate the cells 42 of the rows 38 to atmospheric or zero pressure. It is important to the invention that the deflation of either row of cells not begin until the other row is inflated to ensure adequate support for the patient. A fourth time interval 112 is defined as the time between the establishment of fluid communication between the input and output ports 74, 76 and the establishment of fluid communication between the output and exhaust ports 74, 80. The time interval 112 is a summation of the time intervals 106, 108 and 110.

The output port 76 and exhaust port 80 of the solenoid valve 70 remain in fluid communication with each other for a fifth predetermined time interval 114 which is substantially equal to the second time interval 108. At the end of this time interval, the pump 52 is again actuated and the solenoid valve 70 is switched such that the input port 74 is in fluid communication with the output port 76 for inflating the cells 42 of the rows 38. A sixth time interval 116 is substantially equal to the fourth time interval 114 and is defined as the time between the establishment of fluid

communication between the input and output ports 74, 76 and the establishment of fluid communication between the output and exhaust ports 76, 80. The time interval 116 is a summation of the time intervals 110, 114 and 106. The end of the time interval 114 represents a complete cycle of inflation and deflation of the cells 42 of the first matrix of rows 38 and the second matrix of rows 40. Preferably, a complete cycle is approximately 240 seconds in duration, and each half cycle is approximately 120 seconds in duration.

As shown in FIG. 5, the pump 52 is actuated for only a small interval at the beginning of each half cycle. The time that it takes the pump 52 to pressurize the rows 38 or the rows 40 is monitored by the controller 92. If the pump operates for a time greater than the half cycle (120 seconds) and the pressure in the matrix of rows being pressurized is less than the predetermined pressure, the pump is shut off and an alarm is actuated to notify that a leak in the system has occurred or that the air pump 52 is defective. Likewise, if the pressure detected by the sensor 54 in the pressurized or inflated rows descends below the predetermined pressure during one of the time intervals 112, 116, the alarm is sounded to indicate that a leak is present in the system.

By deflating one set of rows, the patient is moved into a new position in a very careful manner, so that different areas on the patient will be alternatively subjected to the stress of his body weight to thereby prevent decubitus ulcers from developing. It is preferred that the controller operates the inflation and deflation of the rows independently of operator control or intervention. However, the controller 92 may be provided with suitable and well known means for altering one or more of the time intervals 104 to 114 depending on the particular needs of the patient.

FIG. 6 illustrates the relative inflation and deflation rates of the two matrices 38, 50. It will be understood from FIG. 6 that inflation and deflation are not instantaneous. In fact, the rate of deflation is more gradual than the rate of inflation, and deflation of one manifold does not commence until the adjoining manifold is fully inflated. This overlap creates a further effect on the pressure bearing points of the body to minimize decubitus ulcers. Although particular dimensions and cycle times have been given by way of example, it is to be understood that these may greatly vary.

Referring now to FIG. 7, a mattress 120 according to a further embodiment of the invention is shown. The mattress 120 includes a base layer 122 that is preferably constructed of foam that has a resiliency sufficient to support and conform to the contours of a person placed thereon, as in the previous embodiment. A heel portion 124 is provided at one end of the base layer 122 and includes a surface 126 that tapers to a foot end 128 of the mattress 120. An upper layer 130 is attached to the upper surface of the base layer 122 through well-known techniques. Preferably, the upper layer 130 is constructed of a foam that exhibits greater resiliency than the base layer 12 for added comfort to a user. The upper tapered surface 132 in the upper layer 130 receives the heels of a user when the user is lying on his/her back to thereby firmly support the calcaneal tendon and more uniformly distribute pressure from the weight of the user's legs and feet to thereby reduce or eliminate heel pressure and consequent ulcers in the heel region.

FIG. 8 illustrates a third embodiment mattress support system 140 according to the invention. The third embodiment mattress support system 140 provides a unique way to mount the mattress support system to an existing mattress. The third embodiment mattress support system 140 is illustrated using the mattress support system 10; therefore, like numerals will be used to identify like parts.

The mattress support system 140 comprises an external cover 142, which is adapted to overlie and mount to an existing mattress 144. The external cover comprises an upper wall 143 with a downwardly extending peripheral wall 145. An interior web 146 extends across the cover and is connected to the peripheral wall 145 to define a first chamber 148 in which is provided the mattress support system 10. The cover 142 has an access opening 150 formed in its rear surface, which is defined by a peripheral edge 152 of the peripheral wall 145. A drawstring is provided in the peripheral edge 152. The web 146 and the peripheral wall 145 define a closable second chamber 154 having an access opening defined by the peripheral edge 152. The closable second chamber 154 is sized to receive the mattress 144.

To mount the mattress support system 140 to an existing mattress 144, the mattress support system 144 is placed on top of the existing mattress so that the

mattress support system 10 within the chamber 148 and the web 146 overlie the top of the existing mattress 144. The sides of the cover 142 are then folded around and under the mattress 144. The drawstring 154 is drawn tied to snugly envelop the cover about the mattress 144.

The advantage of the mattress support system 140 is that it is easily portable from one location to another and is not dependent upon the size of the existing mattress 144. The cover can be made of sufficient size so that the mattress support system 140 can be fitted to a variety of sizes and shapes of mattresses. Additionally, the fixing of the cover to the mattress 144 by snugging the drawstring 154 provides an easy method for securely fastening the mattress support system 140 to any size mattress.

It should be noted that although the mattress support system 140 is shown using the first embodiment of the mattress support system 110 positioned within the interior chamber 148 of the cover 142, it is within the scope of the invention for any suitable mattress support system, including the second embodiment mattress support system of FIG. 7, to be positioned within the chamber 148. Alternatively, it is required that only the inflatable cells be provided within the chamber 148 for operation of the invention

While particular embodiments of the invention have been shown, it will be understood, of course, that the invention is not limited thereto since modifications may be made by those skilled in the art, particularly in light of the foregoing teachings. Reasonable variation and modification are possible within the scope of the foregoing disclosure of the invention without departing from the spirit of the invention.

CLAIMS

1. A mattress support system for supporting a human being in a manner to reduce the likelihood of decubitus ulcers, the mattress support system comprising:

an inflatable support having at least two series of inflatable cells whereby each series of inflatable cells supports different portions of a human being; and

a base support having an upper surface for supporting the inflatable support and a lower surface, the base support comprising:

a main portion having an upper end and a lower end, and an upper surface and a lower surface, each extending between the upper and lower end, and

a tapered heel portion having an upper end and a lower end, and an upper surface and a lower surface, each extending between the upper and lower ends of the heel portion, wherein the thickness of the tapered heel portion is greater at the heel portion upper end than the heel portion lower end to define the taper to the heel portion.

2. A mattress support system according to claim 1 wherein the heel portion upper surface and the main portion upper surface define at least a portion of the base support upper surface.

3. A mattress support system according to claim 1 wherein the heel portion lower surface and the main portion lower surface define at least a portion of the base support lower surface.

4. A mattress support system according to claim 1 wherein the heel portion lower surface lies generally in a horizontal plane and the heel portion upper surface lies in a plane sloping from the heel portion upper end to the heel portion lower end.

5. A mattress support system according to claim 4 wherein the heel

portion upper end abuts and is generally the same height as the main portion lower end.

6. A mattress support system according to claim 5 wherein the inflatable support wraps around the heel support upper surface, the heel support lower end, and to at least a portion of the heel support lower surface.

7. A mattress support system according to claim 6 wherein each of the at least two series of inflatable cells includes a filler tube and the filler tube is disposed within the heel portion.

8. A mattress support system according to claim 1 wherein the inflatable support wraps around the heel support upper surface, the heel support lower end, and to at least a portion of the heel support lower surface.

9. A mattress support system according to claim 1 wherein the main portion and the heel portion are made from anti-microbial foam.

10. A mattress support system according to claim 9 wherein the main portion and the heel portion are made from the same durometer foam.

11. A mattress support system according to claim 1, and further comprising a lateral support for laterally supporting the inflatable support.

12. A mattress support system according to claim 5 wherein the lateral support is a recessed portion in the upper surface of the base support.

13. A mattress support system according to claim 5 wherein the lateral support is a frame support provided on the upper surface of the base support and defining a recess in which the inflatable support is received for lateral support.

14. A mattress support system according to claim 1, and further comprising a cover having a first chamber in which is received the base support and the inflatable support and a second chamber adapted to receive a mattress whereby the mattress support system is mounted to a mattress.

15. A mattress support system according to claim 14 wherein the cover comprises an upper wall, a peripheral wall depending from the upper wall and terminating in a lower peripheral edge defining an access opening, and a web extending across the peripheral wall and spaced from the upper wall, wherein the upper wall, web, and peripheral wall define the first chamber and the web and peripheral wall define the second chamber with a access opening through which the mattress is received.

16. A mattress support system according to claim 15 wherein a drawstring is provided in the peripheral wall about the lower edge whereby the drawing of the drawstring closed the second opening to mount the mattress support system to a mattress.

17. A mattress support system according to claim 16 wherein the cover is made from a non-permeable material.

18. A mattress support system for supporting a human being in a manner to reduce the likelihood of decubitus ulcers, the mattress support system comprising:

a base support having an upper surface and lower surface opposite therefrom, the upper surface adapted to support a human being and the lower surface adapted to rest on a third surface, each extending between the upper and lower ends; and

an inflatable support provided on the base support and having multiple inflatable cells for supporting different portions of a human being, and the inflatable

support being disposed on at least a portion of both the upper and lower surfaces of the base support.

19. A mattress support system according to claim 18 wherein the inflatable support extends from the upper to the lower surface by wrapping around one of the upper or lower ends of the base support.

20. A mattress support system for supporting a human being to reduce the likelihood of decubitus ulcers, the mattress support system comprising:

a cover having a first chamber and a second closable chamber adapted to receive and substantially enclose a mattress to secure the cover to the mattress; and

an inflatable support provided in the first chamber and having multiple inflatable cells to support different portions of a human being.

21. A mattress support system according to claim 20 wherein the cover comprises an upper wall, a peripheral wall depending from the upper wall and terminating in a lower peripheral edge defining an access opening, and a web extending across the peripheral wall and spaced from the upper wall, wherein the upper wall, web, and peripheral wall define the first chamber and the web and peripheral wall define the second chamber with a access opening through which the mattress is received.

22. A mattress support system according to claim 21 wherein a drawstring is provided in the peripheral wall about the lower edge whereby the drawing of the drawstring closed the second opening to mount the mattress support system to a mattress.

23. A mattress support system according to claim 22 wherein the cover is made from a non-permeable material.

24. A method of operating a mattress support system comprising an inflatable support having at least two series of inflatable cells for use in reducing the likelihood of decubitus ulcers in a human being lying on the cells, the method comprising:

sequentially inflating and deflating each of the at least two series of cells by delaying the deflation of one of the at least two series of cells until after the other of the at least two series of cells is completely inflated thereby ensuring an overlap in the inflated state of at least two series of the at least two series of cells for adequate support of the human being lying on the cells.

25. The method of claim 24, and further comprising an initial inflation step wherein all of the at least two series of cells are inflated prior to the sequential inflating step.

26. The method of claim 25 wherein the initial inflation step lasts for 0 to 30 seconds.

27. The method of claim 24 wherein the rate of inflation for the inflation step is greater than the rate of deflation for the deflation step.

28. The method of claim 24 wherein the cells are inflated up to 4 psig.

29. The method of claim 24 wherein the inflation step lasts for 0 to 30 seconds.

30. The method of claim 28 wherein the deflation step lasts for 0 to 120 seconds.

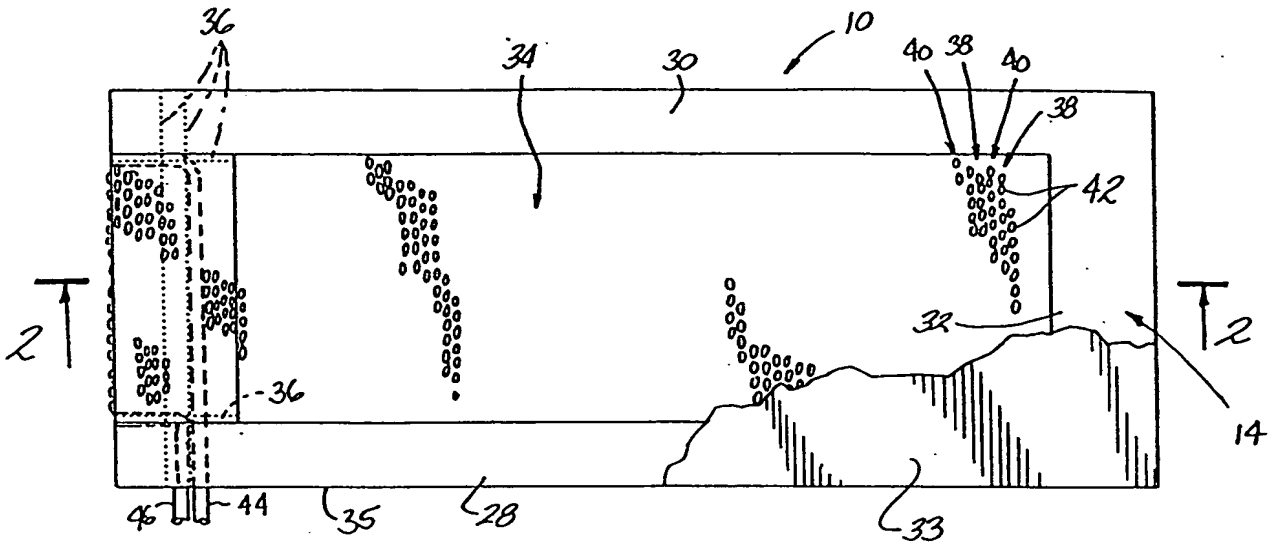

FIG. 1

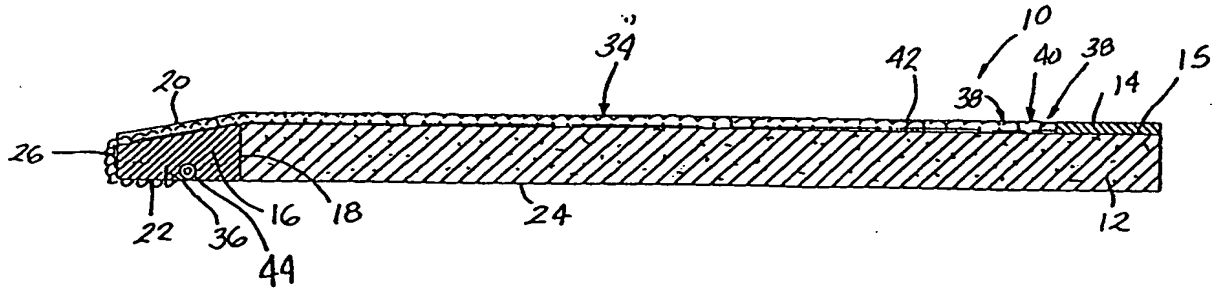

FIG. 2

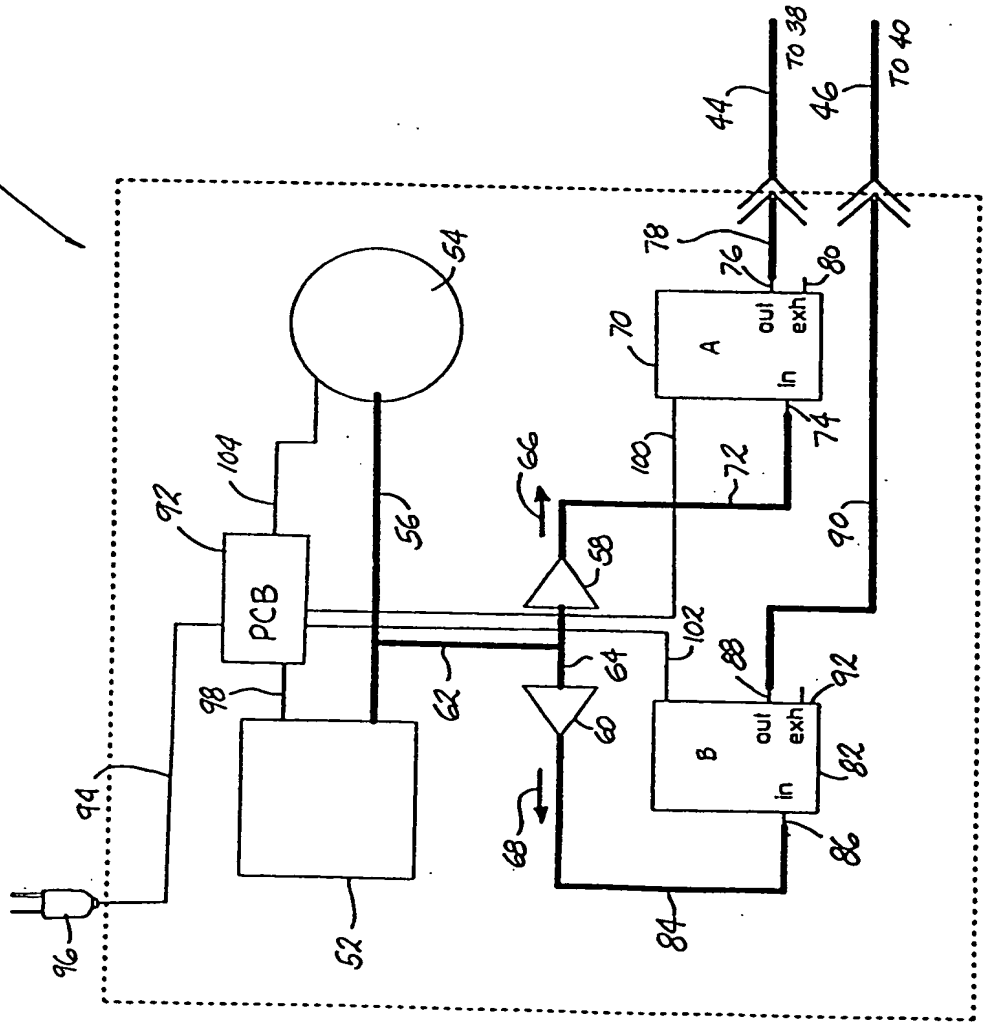
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FIG. 3

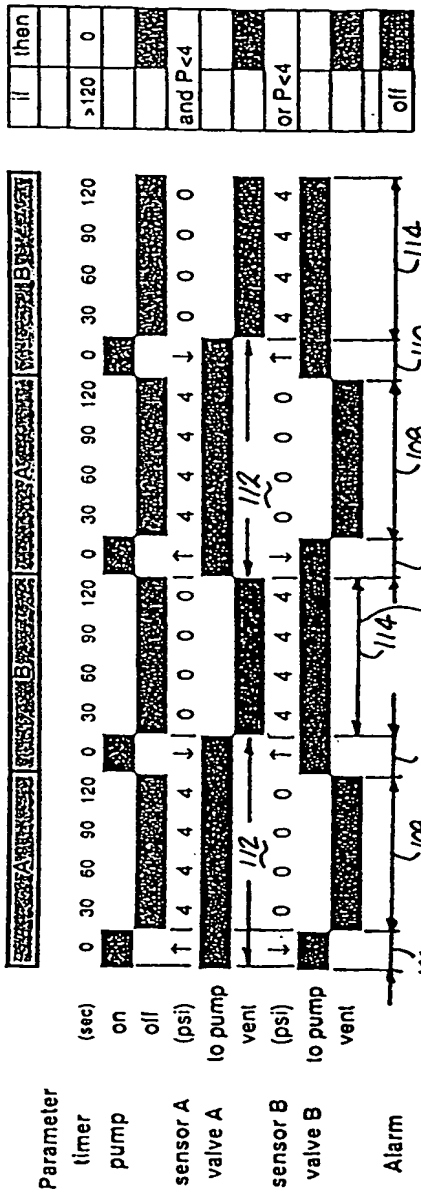

FIG. 5

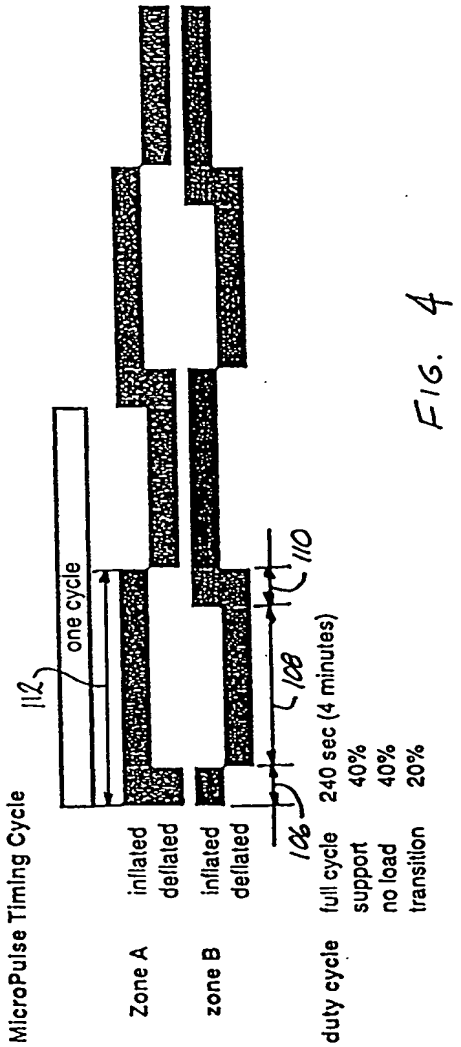

FIG. 4

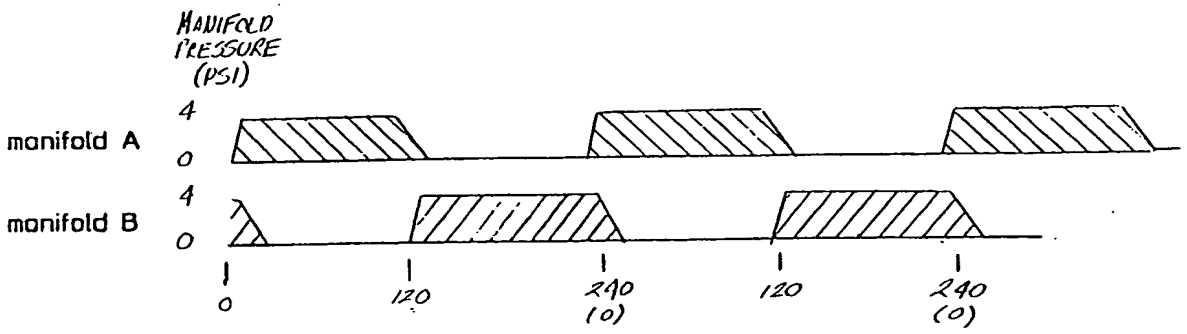

Fig.6

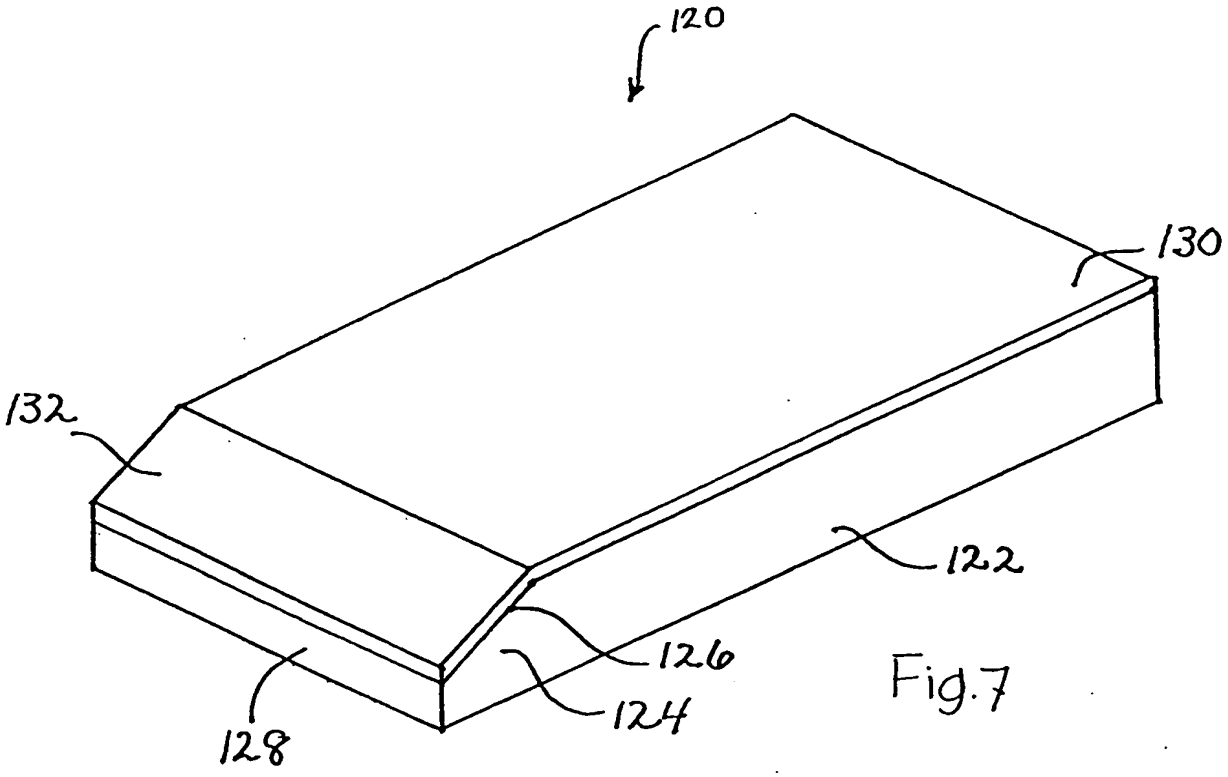

Fig.7

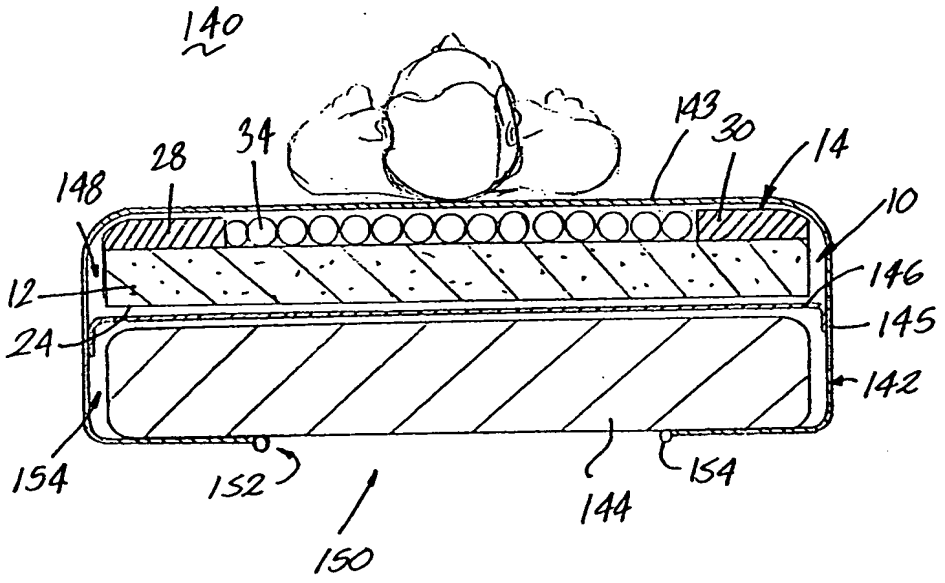

Fig. 8

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/03586

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A47C27/10 A47C27/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A47C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 172 439 A (FARLEY) 22 December 1992 see figures	1
A	US 4 639 960 A (QUILLEN) 3 February 1987 see figures	1
A	US 3 199 124 A (GRANT) 10 August 1965 see the whole document	1
A	US 4 991 244 A (WALKER) 12 February 1991	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
8 June 1998	18/06/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	VandeVondele, J

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 98/03586

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5172439 A	22-12-1992	NONE	
US 4639960 A	03-02-1987	US 4685163 A	11-08-1987
US 3199124 A	10-08-1965	NONE	
US 4991244 A	12-02-1991	CA 2012550 A	05-07-1991